CLAIMS

What is claimed is:

1. A device comprising:

a resonator probe, said resonator probe having a proximal end and a distal end;

a housing;

a horn fixedly secured to said housing and adapted to receive said proximal end of said resonator probe;

a plurality of piezoelectric ceramics contained within said housing;

a capturing mechanism, wherein said capturing mechanism permits said resonator probe to partially disengage said horn; and

a free mass non-fixedly engaging said resonator probe.

2. The device of claim 1, wherein said resonator probe is a one-piece probe.

3. The device of claim 1, wherein said resonator probe is a multi-piece probe.

4. The device of claim 1, wherein said resonator probe is made of a material selected from a group comprising steel, steel alloys, titanium, titanium alloys, combinations thereof, and plastic.

5. The device of claim 1, wherein said distal end of said resonator probe is further comprised of a bit adapted for a particular use, wherein said particular use is selected from a group comprising drilling, coring, mining, sampling, bone grafting, and sounding.

6. The device of claim 1, wherein said plurality of piezoelectric ceramics is compressed by a bolt, said bolt penetrating substantially through said plurality of piezoelectric ceramics.

7. The device of claim 1, wherein said plurality of piezoelectric ceramics is electrically connected to an ultrasonic generator for generating ultrasonic vibrations.

8. The device of claim 1, wherein said device further includes a body sensor-feedback apparatus, said body sensor-feedback apparatus providing an operator of said device with an instantaneous reading and an optimal setting for operating said device.

9. The device of claim 8, wherein said body sensor-feedback apparatus is comprised of a plurality of sensing piezoelectric ceramics, a plurality of driving piezoelectric ceramics, a back mass, a front driver, a buffer/attenuator, a peak detector, an A/D source, a microprocessor, a frequency synthesizer, a switching driver, and an output stage transformer.

10. The device of claim 9, wherein said plurality of sensing piezoelectric ceramics are thin piezoelectric ceramics and act as a body sensor.

11. The device of claim 9, wherein said plurality of driving piezoelectric ceramics are thick piezoelectric ceramics.

12. The device of claim 9, wherein said peak detector further includes a rectification and a filter.

13. The device of claim 9, wherein said A/D source is an analog to digital converter.

14. The device of claim 9, wherein said switching driver generates a high power square waveform having a frequency the same as a frequency signal.

15. The device of claim 9, wherein said output stage transformer increases a voltage of said electrical signal to a level that can activate said plurality of driving piezoelectric ceramics.

16. The device of claim 1, wherein said horn is a stepped horn, said stepped horn being comprised of at least two concentric cylinders of different diameters.

17. The device of claim 1, wherein said capturing mechanism is comprised of a capturing member with an opening and a barrier member with a diameter larger than said opening, said barrier member disposed on said resonator probe, between said horn and said capturing member.

18. The device of claim 17, wherein said capturing mechanism further includes a spring or spring-like material located between said barrier member and said capturing member, and wherein said spring or spring-like material exerts a force against said resonator probe towards said horn.

19. The device of claim 1, wherein said free mass reduces probe frequency from kilohertz to hertz.

20. The device of claim 1, wherein said free mass is made of a metal, said metal selected from a group comprising steel, steel alloys, titanium, titanium alloys, combinations thereof, and plastic.

21. The device of claim 1, wherein said free mass is disposed on said resonator probe between said barrier member and said horn.

22. The device of claim 1, wherein said horn is further comprised of an annular portion, said free mass being positioned within said annular portion of said horn, between said proximal end of said resonator probe and said horn.

23. The device of claim 1, wherein said device further includes at least one additional free mass.

24. The device of claim 6, wherein said device further includes a cooling mechanism.

25. The device of claim 24, wherein said cooling mechanism is comprised of an inlet port and an outlet port extending at least partially a length of said bolt, wherein a cool saline solution passes through said bolt via said inlet port, passes through and cools horn, and then exits said bolt via said exit port.

26. The device of claim 1, wherein said device further includes an irrigation and aspiration mechanism.

27. The device of claim 26, wherein said irrigation and aspiration mechanism is comprised of an adaptor, at least one vacuum exit or entrance, and a pump assembly.

28. The device of claim 1, wherein said device further includes an electrical connection between said plurality of piezoelectric ceramics and an ultrasonic generator for generating ultrasonic vibrations in said plurality of piezoelectric ceramics.

29. An ultrasonic device comprising:

a resonator probe, said resonator probe having a proximal end and a distal end;

a housing;

a horn fixedly secured to said housing and adapted to receive said proximal end of said resonator probe;

a plurality of piezoelectric ceramics contained within said housing;

a capturing member functionally engaging said horn and at least partially enclosing said resonator probe, wherein said capturing member is comprised of an opening through which said distal end of said resonator probe protrudes and permits said resonator probe to partially disengage said horn;

a barrier member disposed on said resonator probe between said horn and said capturing member and having a diameter larger than said opening of said capturing member; and

a free mass functionally engaging said resonator probe.

30. The ultrasonic device of claim 29, wherein said resonator probe is a one-piece probe.

31. The ultrasonic device of claim 29, wherein said resonator probe is a multi-piece probe.

32. The ultrasonic device of claim 29, wherein said resonator probe is made of a material selected from a group comprising steel, steel alloys, titanium, titanium alloys, combinations thereof, and plastic.

33. The ultrasonic device of claim 29, wherein said distal end of said resonator probe is further comprised of a bit adapted for a particular use, wherein said

particular use is selected from a group comprising drilling, coring, mining, sampling, bone grafting, and sounding.

34. The ultrasonic device of claim 29, wherein said plurality of piezoelectric ceramics is compressed by a bolt, said bolt penetrating substantially through said plurality of piezoelectric ceramics.

35. The ultrasonic device of claim 29, wherein said plurality of piezoelectric ceramics is electrically connected to an ultrasonic generator for generating ultrasonic vibrations.

36. The ultrasonic device of claim 29, wherein said device further includes a body sensor-feedback apparatus for providing an instantaneous reading to an operator of said ultrasonic device with an optimal setting for operating said ultrasonic device.

37. The ultrasonic device of claim 36, wherein said body sensor-feedback apparatus is comprised of a plurality of sensing piezoelectric ceramics, a plurality of driving piezoelectric ceramics, a back mass, a front driver, a buffer/attenuator, a peak detector, an A/D source, a microprocessor, a frequency synthesizer, a switching driver, and an output stage transformer.

38. The ultrasonic device of claim 37, wherein said plurality of sensing piezoelectric ceramics are thin piezoelectric ceramics and act as a body sensor.

39. The ultrasonic device of claim 37, wherein said plurality of driving piezoelectric ceramics are thick piezoelectric ceramics.

40. The ultrasonic device of claim 37, wherein said peak detector further includes a rectification and a filter.

41. The ultrasonic device of claim 37, wherein said A/D source is an analog to digital converter.

42. The ultrasonic device of claim 37, wherein said switching driver generates a high power square waveform having a frequency the same as a frequency signal.

43. The ultrasonic device of claim 37, wherein said output stage transformer increases a voltage of said electrical signal to a level that can activate said plurality of driving piezoelectric ceramics.

44. The ultrasonic device of claim 29, wherein said horn is a stepped horn, said stepped horn being comprised of at least two concentric cylinders of different diameters.

45. The ultrasonic device of claim 29, wherein said ultrasonic device further includes a spring or spring-like material located between said barrier member and said capturing member, wherein said spring or spring-like material exerts a force against said resonator probe towards said horn.

46. The ultrasonic device of claim 29, wherein said free mass reduces probe frequency from kilohertz to hertz.

47. The ultrasonic device of claim 29, wherein said free mass is made of a metal, said metal selected from a group comprising steel, steel alloys, titanium, titanium alloys, plastic, and combinations thereof.

48. The ultrasonic device of claim 29, wherein said free mass is disposed on said resonator probe between said barrier member and said horn.

49. The ultrasonic device of claim 29, wherein said horn further includes an annular portion, said free mass being positioned within said annular portion of said horn, between said proximal end of said resonator probe and said horn.

50. The ultrasonic device of claim 29, wherein said device further includes at least one additional free mass.

51. The ultrasonic device of claim 34, wherein said device further includes a cooling mechanism.

52. The ultrasonic device of claim 51, wherein said cooling mechanism is comprised of an inlet port and an outlet port extending substantially a length of said bolt, wherein a cool saline solution passes through said bolt via said inlet port, passes through and cools horn, and then exits said bolt via said exit port.

53. The ultrasonic device of claim 29, wherein said ultrasonic device further includes an irrigation and aspiration mechanism, wherein said irrigation and aspiration mechanism is comprised of an adaptor, at least one vacuum exit or entrance, and a pump assembly.

54. The ultrasonic device of claim 29, wherein an ultrasonic generator is electrically connected to said plurality of piezoelectric ceramics for generating ultrasonic vibrations in said plurality of piezoelectric ceramics.

55. A system comprising:

a resonator probe, said probe having a proximal end and a distal end;

a housing;

a plurality of piezoelectric ceramics contained within said housing;

a horn fixedly secured to said housing and adapted to receive said proximal end of said resonator probe;

a capturing mechanism, wherein said capturing mechanism permits said resonator probe to partially disengage said horn;

a free mass functionally engaging said resonator probe; and

an ultrasonic generator for generating ultrasonic vibrations in said plurality of piezoelectric ceramics, wherein said ultrasonic generator is electrically connected to said plurality of piezoelectric ceramics.

56. The system of claim 55, wherein said resonator probe is a one-piece probe.

57. The system of claim 55, wherein said resonator probe is a multi-piece probe.

58. The system of claim 55, wherein said resonator probe is made of a material selected from a group comprising steel, steel alloys, titanium, titanium alloys, combinations thereof, and plastic.

59. The system of claim 55, wherein said distal end of said resonator probe is further comprised of a bit adapted for a particular use, wherein said particular use is selected from a group comprising drilling, coring, mining, sampling, bone grafting, and sounding.

60. The system of claim 55, wherein said plurality of piezoelectric ceramics is compressed by a bolt, said bolt penetrating substantially through said plurality of piezoelectric ceramics.

61. The system of claim 55, wherein said plurality of piezoelectric ceramics is electrically connected to an ultrasonic generator for generating ultrasonic vibrations.

62. The system of claim 55, wherein said device further includes a body sensor-feedback apparatus, said body sensor-feedback apparatus providing an operator with an instantaneous reading of an optimal setting for operating said system.

63. The device of claim 62, wherein said body sensor-feedback apparatus is comprised of a plurality of sensing piezoelectric ceramics, a plurality of driving piezoelectric ceramics, a back mass, a front driver, a buffer/attenuator, a peak detector, an A/D source, a microprocessor, a frequency synthesizer, a switching driver, and an output stage transformer.

64. The device of claim 63, wherein said plurality of sensing piezoelectric ceramics are thin piezoelectric ceramics and act as a body sensor.

65. The device of claim 63, wherein said plurality of driving piezoelectric ceramics are thick piezoelectric ceramics.

66. The device of claim 63, wherein said peak detector further includes a rectification and a filter.

67. The device of claim 63, wherein said A/D source is an analog to digital converter.

68. The device of claim 63, wherein said switching driver generates a high power square waveform having a frequency the same as a frequency signal.

69. The device of claim 63, wherein said output stage transformer boosts a voltage of said electrical signal to a level that can activate said plurality of driving piezoelectric ceramics.

70. The system of claim 55, wherein said horn is a stepped horn, said stepped horn being comprised of at least two concentric cylinders of different diameters.

71. The system of claim 55, wherein said capturing mechanism is comprised of a capturing member with an opening and a barrier member with a diameter larger than said opening, said barrier member located on said resonator probe, between said horn and said capturing member.

72. The system of claim 71, wherein said capturing mechanism further includes a spring or spring-like material located between said barrier member and said capturing member, and wherein said spring or spring-like material exerts a force against said resonator probe in the direction of said horn.

73. The system of claim 55, wherein said free mass reduces probe frequency from kilohertz to hertz.

74. The system of claim 55, wherein said free mass is made of a metal, said metal selected from a group comprising steel, steel alloys, titanium, titanium alloys, combinations thereof, and plastic.

75. The system of claim 55, wherein said free mass is disposed on said resonator probe between said barrier member and said horn.

76. The system of claim 55, wherein said horn is further comprised of an annular portion, said free mass being positioned within said annular portion of said horn, between said proximal end of said resonator probe and said horn.

77. The system of claim 55, wherein said device further includes at least one additional free mass.

78. The system of claim 60, wherein said device further includes a cooling mechanism.

79. The system of claim 78, wherein said cooling mechanism is comprised of an inlet port and an outlet port extending substantially a length of said bolt, wherein a cool saline solution passes through said bolt via said inlet port, passes through and cools horn, and then exits said bolt via said exit port.

80. The system of claim 55, wherein said device further includes an irrigation and aspiration mechanism, wherein said irrigation and aspiration mechanism is comprised of an adaptor, at least one vacuum exit or entrance, and a pump assembly.